

Cyclotronic Plasma Actuator with Arc-Magnet for Active Flow Control, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



ABSTRACT

CU Aerospace and team partner the University of Illinois at Urbana-Champaign propose to develop a new type of plasma-based flow control actuator, which uses a high-voltage electrode that arcs to a cylindrical grounded electrode within a magnetic field. The result is that an arc plasma can be produced, with a Lorentz force that creates a plasma disc (similar concept to a cyclotron). The thought behind this concept is that the thermal actuator authority provided by the plasma arc is coupled with an induced swirl component into a boundary-layer flow, which will enhance mixing and allow flows to remain attached in high adverse pressure gradients. Effectively, the proposed actuator would function like vortex generators that one could enable or disable on command. This subsystem demonstration will pioneer a family of devices to address a notoriously difficult problem in active flow control.

ANTICIPATED BENEFITS

To NASA funded missions:

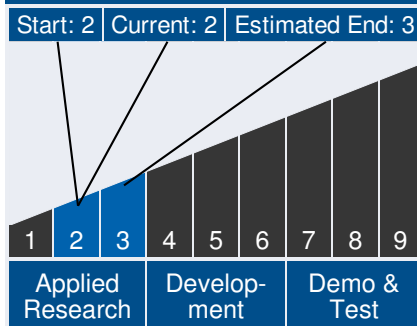
Potential NASA Commercial Applications: The anticipated benefits of the proposed cyclotronic plasma actuator are improved actuator authority and improved effectiveness for low-speed and high-speed flows, when compared to traditional dielectric barrier discharge plasma actuators. Additional benefits are anticipated for alleviation of turbulent separation through 3D mixing mechanisms, similar to passive vortex generators. It is anticipated that this mixing mechanism will also provide an improvement in operational efficiency, or reduced power requirements, for the proposed actuator, as compared to existing technologies. The proposed innovation also has the benefit over passive devices, as control authority can be provided on-demand and it does not produce undesirable parasite drag during high-speed cruise. Additionally, the actuator has no moving parts and does not require the heavy infrastructures and mechanical complexities associated with



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Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

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high-pressure air storage.

To the commercial space industry:

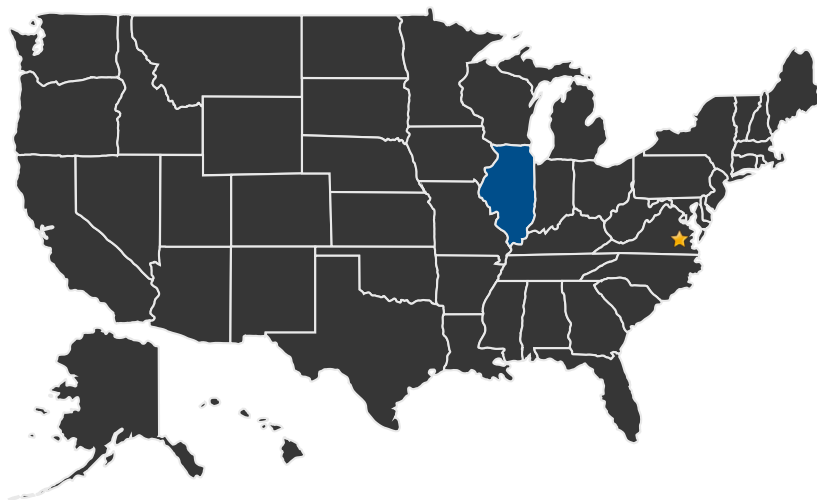
Potential Non-NASA Commercial Applications: The use of the cyclotronic plasma actuator also has potential to lead to significant reductions in drag and fuel burn for commercial aircraft through improved control surface effectiveness and high-lift performance, allowing the weight and size of aerodynamic surfaces to be reduced. Operational benefits are also anticipated for the efficiency, maneuverability, and stall prevention of military aircraft in high angle of attack operation.

Management Team (cont.)

Principal Investigator:

- David Carroll

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States
With Work

★ **Lead Center:**
Langley Research Center

Other Organizations Performing Work:

- CU Aerospace, LLC (Champaign, IL)

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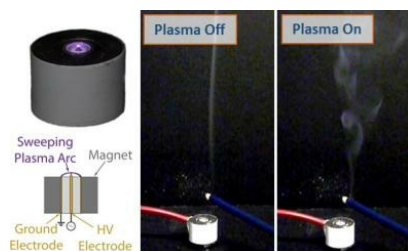


PROJECT LIBRARY

Presentations

- Briefing Chart
 - (<http://techport.nasa.gov:80/file/23445>)

IMAGE GALLERY



Cyclotronic Plasma Actuator with Arc-Magnet for Active Flow Control, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

Cyclotronic Plasma Actuator with Arc-Magnet for Active Flow Control, Phase I

Potential Applications

The anticipated benefits of the proposed cyclotronic plasma actuator are improved actuator authority and improved effectiveness for low-speed and high-speed flows, when compared to traditional dielectric barrier discharge plasma actuators. Additional benefits are anticipated for alleviation of turbulent separation through 3D mixing mechanisms, similar to passive vortex generators. It is anticipated that this mixing mechanism will also provide an improvement in operational efficiency, or reduced power requirements, for the proposed actuator, as compared to existing technologies. The proposed innovation also has the benefit over passive devices, as control authority can be provided on-demand and it does not produce undesirable parasite drag during high-speed cruise. Additionally, the actuator has no moving parts and does not require the heavy infrastructures and mechanical complexities associated with high-pressure air storage.